WHAT IS CLAIMED IS

1. An image processing apparatus which processes image data and outputs the processed image data, comprising:

a maximum/minimum density detecting unit detecting whether a center pixel of a matrix of N x N pixels in the image data has a maximum or minimum density among the pixels of the matrix;

a center pixel selecting unit selecting one of neighboring pixels of the matrix adjacent to the center pixel as being an active center pixel;

a diagonal pixel selecting unit selecting one of pairs of diagonal pixels of the matrix at positions symmetrical with respect to the center pixel as being active diagonal pixels;

a determination unit determining whether the absolute value of a difference between an average of densities of all the pairs of diagonal pixels selected by the diagonal pixel selecting unit and a density of the center pixel selected by the center pixel selecting unit is larger than a predetermined threshold value;

a peak pixel detecting unit detecting peak pixels of the matrix, each peak pixel being the center pixel detected as having the maximum or minimum density by the maximum/minimum density detecting unit, and the absolute value of the difference with respect

to the center pixel determined as being larger than the threshold value by the determination unit; and

a dot region detecting unit detecting one of the neighboring pixels including the peak pixels as being a dot region based on a relationship between the number of the peak pixels in a two-dimensional target region and the number of the peak pixels in each of two-dimensional neighboring regions of the target region.

2. The image processing apparatus of claim 1 wherein the center pixel selecting unit selects one of the neighboring pixels as being the active center pixel when said one of the neighboring pixels has the maximum or minimum density.

3. The image processing apparatus of claim 1 wherein the diagonal pixel selecting unit selects one of the pairs of diagonal pixels as being the active diagonal pixels when said one of the pairs of diagonal pixels has the maximum or minimum density.

4. A low-linear-density dot region detecting device which detects a low-linear-density dot region of image data, comprising:

a maximum/minimum density detection unit detecting whether a center pixel of a matrix of N x N pixels in the image data has a maximum or minimum density among the pixels of the matrix;

a determination unit determining whether the absolute value of a difference between an average of respective densities of all pairs of diagonal pixels of the matrix at positions symmetrical with respect to the center pixel and a density of the center pixel is larger than a predetermined threshold value;

a peak pixel detection unit detecting peak pixels of the matrix, each peak pixel being the center pixel detected as having the maximum or minimum density, and the absolute value of the difference with respect to the center pixel determined as being larger than the threshold value;

a peak pixel erasing unit making the detected peak pixels inactive when a periodicity between the detected peak pixels is below a fixed value; and

a low-linear-density dot region detecting unit detecting one of neighboring pixels of the matrix, including a target pixel, as being a low-linear-density dot region based on a relationship between the number of the peak pixels in a two-

dimensional target region and the number of the peak pixels in each of two-dimensional neighboring regions of the target region.

5. The low-linear-density dot region detection apparatus of claim 4 wherein the determination unit compares densities of a center group of adjacent pixels of the matrix surrounding the center pixel and densities of a circumferential group of pairs of circumferential pixels of the matrix at positions symmetrical with respect to the center pixel.

6. The low-linear-density dot region detection apparatus of claim 5 wherein the pixels of the circumference group are chosen according to a ratio of copy expansion or reduction which is specified by a document scanning speed.

7. The low-linear-density dot region detection apparatus of claim 4 further comprising:

a first periodicity check unit which detects a periodicity between the peak pixels having a maximum density among the pixels of the matrix; and

a second periodicity check unit which detects a periodicity between the peak pixels having a minimum density among the pixels of the matrix,

wherein the detection of the first periodicity check unit and the detection of the second periodicity check unit are performed independently.

8. The low-linear-density dot region detection apparatus of claim 7 wherein the first periodicity check unit detects an interval of the peak pixels with the maximum density in a main scanning direction, and the second periodicity check unit detects an interval of the peak pixels with the minimum density in the main scanning direction.

9. The low-linear-density dot region detection apparatus of claim 4 wherein the fixed value used by the peak pixel erasing unit is predetermined by a value corresponding to a theoretical low-linear-density value.

10. An image processing apparatus including a low-linear-density dot region detection device and an image processing device, the image processing device processing image data and outputting the processed image data, the low-linear-density dot region detection device comprising:

a maximum/minimum density detection unit detecting whether a center pixel of a matrix of N x N pixels in the image data has a maximum or minimum density among the pixels of the matrix;

a determination unit determining whether the absolute value of a difference between an average of respective densities of all pairs of diagonal pixels of the matrix at positions symmetrical with respect to the center pixel and a density of the center pixel is larger than a predetermined threshold value;

a peak pixel detection unit detecting peak pixels of the matrix, each peak pixel being the center pixel detected as

having the maximum or minimum density, and the absolute value of the difference with respect to the center pixel determined as being larger than the threshold value;

a peak pixel erasing unit making the detected peak pixels inactive when a periodicity between the detected peak pixels is below a fixed value; and

a low-linear-density dot region detecting unit detecting one of neighboring pixels of the matrix, including a target center pixel, as being a low-linear-density dot region based on a relationship between the number of the peak pixels in a two-dimensional target region and the number of the peak pixels in each of two-dimensional neighboring regions of the target region,

wherein the image processing device performs selectively one of a first image processing for pixels of the low-linear-density dot region detected by the low-linear-density dot region detection device and a second image processing for pixels of another dot region of the image data.

11. An image processing apparatus which processes image data and outputs the processed image data, comprising:

a determination unit determining whether the absolute value of a difference between an average of respective densities of all pairs of diagonal pixels of a matrix of N x N pixels at positions symmetrical with respect to a center pixel of the matrix and a density of the center pixel is larger than a predetermined threshold value;

a peak pixel detection unit detecting peak pixels of the matrix, each peak pixel being the center pixel detected as having a maximum or minimum density among the pixels of the matrix, and the absolute value of the difference with respect to the center pixel determined as being larger than the threshold value;

a dot region detecting unit detecting one of neighboring pixels of the matrix, including the peak pixels, as being a dot region based on a relationship between the number of the peak pixels in a two-dimensional target region and the number of the peak pixels in each of two-dimensional neighboring regions of the target region;

a low-linear-density dot region detection unit detecting one of the neighboring pixels of the matrix as being a low-linear-density dot region based on the relationship of the number of the peak pixels between the target region and each neighboring region; and

an image processing switching unit switching one of a first image processing and a second image processing to the other, when processing the pixels of the image data, based on

a result of the detecti n of the dot region detection unit and a result of the detection of the low-linear-density dot region detection unit.

12. The image processing apparatus of claim 11 wherein the low-linear-density dot region detection unit includes a maximum/minimum density detecting unit which detects whether a center pixel of the matrix of N x N pixels has a maximum or minimum density among the pixels of the matrix.

13. The image processing apparatus of claim 11 wherein the image processing switching unit includes a first filter for the first image processing of the dot region and a second first for the second image processing of the low-linear-density dot region, the second filter having smoothing coefficients larger than smoothing coefficients of the first filter.

14. The image processing apparatus of claim 11 wherein the determination unit densities of a center group of adjacent pixels of the matrix surrounding the center pixel and densities of a circumferential group of pairs of circumferential pixels of the matrix at positions symmetrical with respect to the center pixel.

15. The image processing apparatus of claim 14 wherein the pixels of the circumference group are chosen according to a ratio of copy expansion or reduction which is specified by a document scanning speed.

16. The image processing apparatus of claim 11 wherein further comprising:

a first periodicity check unit which detects a periodicity between the peak pixels having a maximum density among the pixels of the matrix; and

a second periodicity check unit which detects a periodicity between the peak pixels having a minimum density

among the pixels of the matrix,

wherein the detection of the first periodicity check unit and the detection of the second periodicity check unit are performed independently.

17. The image processing apparatus of claim 16 wherein the first periodicity check unit detects an interval of the peak pixels with the maximum density in a main scanning direction, and the second periodicity check unit detects an interval of the peak pixels with the minimum density in the main scanning direction.

18. An image forming apparatus including an image processing apparatus and an image output device, the image processing apparatus processing image data and outputting the processed image data, and the image output device printing an image based on the processed image data from the image processing apparatus, the image processing apparatus comprising:

a maximum/minimum density detecting unit detecting a center

pixel of a matrix of N x N pixels in the image data that has a maximum or minimum density among the pixels of the matrix;

a center pixel selecting unit selecting one of neighboring pixels of the matrix adjacent to the center pixel as being an active center pixel;

a diagonal pixel selecting unit selecting one of pairs of diagonal pixels of the matrix at positions symmetrical with respect to the center pixel as being active diagonal pixels;

a determination unit determining whether the absolute value of a difference between an average of densities of all the pairs of diagonal pixels selected by the diagonal pixel selecting unit and a density of the center pixel selected by the center pixel selecting unit is larger than a predetermined threshold value;

a peak pixel detecting unit detecting peak pixels of the matrix, each peak pixel being the center pixel detected as having the maximum or minimum density by the maximum/minimum density detecting unit, and the absolute value of the difference with respect to the center pixel is determined as being larger than the threshold value by the determination unit; and

a dot region detecting unit detecting one of the neighboring pixels including the peak pixels as being a dot region based on a relationship between the number of the peak pixels in a two-dimensional target region and the number of the peak pixels in each of two-dimensional neighboring regions of the target region.

19. The image forming apparatus of claim 18 further comprising a control unit which analyzes an externally supplied print command and controls the image output device to perform the printing of the image based on the processed image data in accordance with the print command.

20. A color copier including an image processing apparatus, an image reading device and an image printing device, the image reading device reading an image data from a document by color separation and supplying the image data to the image processing apparatus, and the image printing device forming a reconstructed image based on a processed image data output by the image processing apparatus and printing the reconstructed image, the image processing apparatus comprising:

a maximum/minimum density detecting unit detecting a center pixel of a matrix of N x N pixels in the image data that has a maximum or minimum density among the pixels of the matrix;

a center pixel selecting unit selecting one of neighboring pixels of the matrix adjacent to the center pixel as being an active center pixel;

a diagonal pixel selecting unit selecting one of pairs of diagonal pixels of the matrix at positions symmetrical with respect

to the center pixel as being active diagonal pixels;

a determination unit determining whether the absolute value of a difference between an average of densities of all the pairs of diagonal pixels selected by the diagonal pixel selecting unit and a density of the center pixel selected by the center pixel selecting unit is larger than a predetermined threshold value;

a peak pixel detecting unit detecting peak pixels of the matrix, each peak pixel being the center pixel detected as having the maximum or minimum density by the maximum/minimum density detecting unit, and the absolute value of the difference with respect to the center pixel is determined as being larger than the threshold value by the determination unit; and

a dot region detecting unit detecting one of the neighboring pixels including the peak pixels as being a dot region based on a relationship between the number of the peak pixels in a two-dimensional target region and the number of the peak pixels in each of two-dimensional neighboring regions of the target region.